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# ANAEROBIC DIGESTION AND THE STANDARD OFFER PROGRAM

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## INTRODUCTION

In November 2006, a Standard Offer Program (SOP) was introduced by the Ontario provincial government to provide long-term prices for the sale of electrical power generated from renewable energy sources in Ontario. The SOP will bring about a variety of new opportunities for energy generation in Ontario. One area of considerable interest to the agriculture and food sector will be the production of biogas from the anaerobic digestion (AD) of manure, energy crops and other agricultural or food-based materials. This Factsheet outlines some of the basics of the SOP and gives information on biogas systems and their application in Ontario.

It is important to keep up to date as new developments unfold in the electricity sector. Please consult the Standard Offer Program information prepared by the Ontario Power Authority for more details: www.powerauthority.on.ca/sop.

## THE STANDARD OFFER PROGRAM

The Standard Offer Program was developed to provide opportunities to integrate small- and medium-scale renewable energy projects into Ontario's electricity supply system. The details of the SOP were developed by the Ontario Power Authority in conjunction with other industry stakeholders, including the Ontario Energy Board (OEB) and the Ontario Ministry of Energy. The OPA undertook extensive consultations and developed the SOP using the following guiding principles. The program should:

- be kept simple
- focus on removing barriers to smaller clean or renewable energy generation
- balance between the government's renewable energy generation targets and the value of the electricity to the ratepayer
- be built on the early efforts of the Ontario Sustainable Energy Association

## RENEWABLE ENERGY OPPORTUNITIES IN AGRICULTURE

Renewable electrical generation generally includes power produced from wind, biomass, water and solar systems. Other renewable energy systems, such as ground-source heat pumps and solar walls, provide opportunities for energy savings, but these systems do not result in new electricity generation. For agricultural situations, wind, solar and biogas systems are considered to have the highest immediate potential for electrical power production with the broadest application around the province.

For more information on wind and solar power, visit the websites of the Ontario Sustainable Energy Association (www.ontario-sea.org), the Canadian Wind Energy Association (www.canwea.ca) and the Canadian Solar Industries Association (www.cansia.ca).

## HOW DOES THE STANDARD OFFER PROGRAM WORK?

The Standard Offer Program will give generators of electrical power meeting the criteria for renewable energy a fixed price of 11¢/kWh for the electricity put on the Ontario grid. This price is available for wind, biomass (including biogas) and small hydro developments. Energy from photovoltaic (solar electric) technology will receive 42¢/kWh.

The electricity contract guarantees payments for a 20-year period. The prices for non-solar power will be increased at a rate of 20% of the consumer price index per year.

Because of the SOP funding process, the OPA will claim benefits from certain environmental programs, which will mean they are not available or partially available to the alternative power generator. For example, all payments received under the federal ecoENERGY for Renewable Power program (formerly the Renewable

Power Production Incentive or RPPI) will be shared equally between the OPA and the energy generator. The OPA will post details on its website listing programs that give payment directly to the energy generator, for example, capital grants or tax incentives.

There is no minimum production capacity to participate. A maximum limit of 10 MW exists.

## PEAK POWER TIMES

There is an additional rate of 3.52¢/kWh for power produced during peak times. The peak power price boost will only be available to generators able to generate during 80% of peak hours. Most biogas systems will achieve this requirement.

Peak power times occur between 11 AM and 7 PM, Monday to Friday, during regular working days, meaning roughly 2,000 available peak power hours per year.

Generation during off-peak hours will receive the base rate of 11¢/kWh. A standard, farm-based biogas system would operate a minimum of about 3,000 hours per year. If this operation always produces during the peak periods, the maximum blended rate paid will be about 13.4¢/kWh.

If the generator runs almost continuously (8,000 hours per year), the blended rate paid will be about 11.9¢/kWh.

Designing a system to operate only a portion of the time (such as during peak hours) adds additional costs due to:

- the increased size of generator system and associated line connection
- the cost of additional biogas storage
- the requirement to utilize engine or biogas treatment systems that function properly with daily shutdowns

## TRANSMISSION CONSTRAINT ZONE

At the time of writing (March 2007), there is a restricted transmission constraint zone (see Figure 1, right) where only the following new projects can be built under the SOP:

- micro projects that have a capacity of ≤10 kW
- farm based bio-energy projects that have a capacity of ≤250 kW

**Figure 1**. Location of transmission constraint zone in the Ontario electrical transmission system.

The aggregate capacity of all the projects in the zone cannot exceed 10,000 kW (10 MW).

A farm-based bio-energy project is defined as a project that forms part of an Ontario-situated farming business (as defined in the *Farm Registration and Farm Organization Funding Act*, 1993 (Ontario)) operated by the applicant or a person not at arm's length to the applicant, that generates electricity from renewable biomass, biogas or biofuel.

A 250-kW farm-based project running 8,000 hours per year would require manure from 3,000 head of beef feeder cattle if manure were the sole input. If energy crops were the sole input, approximately 125 ha of corn silage would be required to feed this size of digester.

## USAGE OF RENEWABLE POWER BY THE FARMSTEAD

At the time of writing (March 2007), it is understood that if a generator were metered within the farmstead, the farmer would get paid the SOP price for all the generated power and would pay the Hourly Ontario Energy Price (HOEP) for the power used within the same hour. Thus, the farmer would not pay the transmission and distribution costs for the power used. This adds value for a farmstead that uses significant power at the same time it is generated. The effect of other fees, such as demand charges, will depend on the customer's specific situation.

**Figure 2.** View of anaerobic digester.

## BIOGAS FROM ANAEROBIC DIGESTION OF ORGANIC INPUTS: A QUICK EXPLANATION

At a livestock or crop farm, biogas will be produced from the anaerobic digestion (AD) of organic materials such as manure, agricultural residues, food-based organic materials and energy crops (see Figure 2, above). As organic matter is broken down by anaerobic bacteria, biogas is produced.

Biogas primarily contains methane (50%–60%), carbon dioxide and water vapour. Natural gas contains over 99% methane, meaning biogas is essentially diluted natural gas. Biogas produces electricity when used as a fuel in an engine that drives a generator. Often in agricultural systems, a standard diesel or spark engine is modified to burn the biogas to turn a generator to produce electricity. Between 25% to 40% of the energy in the biogas is converted to electricity. The remaining available energy is converted to heat that is used to heat the materials in the anaerobic digester and for other purposes, such as heating a home, shop or greenhouse.

Anaerobic digestion of manure produces an end product (called digestate) that in many cases has at least a 97% reduction in pathogen and odour levels. While there is little volume or nutrient reduction in anaerobic digestion systems, a higher percentage of the nutrients in the digestate are in an inorganic form, similar to conventional fertilizer. Typically, the digestate is land-applied in a manner similar to liquid manure for use with conventional field crops. Timing of application is critical, since the readily available nutrients could be lost if not quickly utilized by the crop.

Digestate can be passed through a solid separator system that produces a high-quality solid material. This material could be used in other settings such as horticultural applications. This may assist the nutrient management plan for the farm by moving nutrients (contained in the solid material) off the farm. In addition, this separated solid material works effectively as a livestock bedding material.

An effective biogas plant optimizes many biological and mechanical processes. Proper equipment and training are necessary to ensure good operation. Countries such as Germany, Switzerland, Austria and Denmark have excellent experience with these systems; however, consideration must be made to address differences in climate, rules and electrical processes when considering imported technologies.

More information on AD systems is available in the OMAFRA Factsheet 04-097, *Anaerobic Digestion Basics.*

## VIABILITY OF BIOGAS SYSTEMS UNDER THE STANDARD OFFER PROGRAM

Calculations completed by OMAFRA indicate that an electricity price of between 13.3¢/kWh and 22¢/kWh is necessary to operate an economically viable biogas system. The range in values depends on size of operation, use of energy crops and the need to produce power during peak periods.

The economics may be improved if good-quality, off-farm organic inputs (such as food processing byproducts) are used in the biogas system. Increased income will be derived from higher biogas production and possibly from tipping fees. Note: A Certificate of Approval (C of A) may be required from the Ministry of Environment (MOE) to accept many of these food-based materials (contact your local MOE office: www.ene.gov.on.ca/envision/org/op.htm).

Most biogas plants produce surplus heat. There is potential to improve the economics by using this heat to replace conventional heat sources.

## MATERIALS TO BE MIXED IN AN ANAEROBIC DIGESTER

A digester requires "volatile organic material" to produce biogas. Historically, manure has been the primary source of material that is digested. Manure can be provided daily and contains material readily broken down by anaerobic bacteria. Farm-based materials, including straw (used in bedding), waste feed, grain cleanings and horticultural byproducts, can also be digested. In addition to farm-based materials, other food or plant-based materials can be digested successfully. Lab tests can determine the biogas production potential of different materials.

Energy crops such as corn silage can also be used in the digester. European numbers indicate that almost 16,000 kWh of electricity (plus equal heat) can be produced from corn silage produced from 1 ha (yield of 45 wet tonnes). Since there are expenses to growing and

harvesting energy crops, 16¢/kWh–22¢/kWh is likely required to obtain adequate return.

Producers must ensure the material does not contain components that may inhibit the biological process or eventually cause the process to stop. For example, antibiotics or high levels of nitrogen in the material may inhibit the biological process. Sand in the material will also affect the capacity of the digester when it settles to the bottom; it may also be difficult to remove.

## SIZE OF BIOGAS SYSTEMS

Based on European experience, farm-based AD systems will range from 30 kW to 1 MW. The size of the generator will depend on the availability of inputs (such as manure). The addition of energy crops and/or off-farm source organics will greatly increase the size of a system on a smaller livestock farm.

## CONNECTING TO THE GRID

If you are considering implementing a biogas system at your farm, consider the following:

- Is 3-phase power available? Three-phase power allows for greater power input into the grid. It also allows for more stable operation of the generator set (talk to your local power distribution company).
- Is grid capacity available to accept power? An assessment of grid capacity must be completed by the power company.
- Are there initial and/or ongoing costs associated with having a connection? For example, special switches may be required on the line to protect the generator and/or other users. Additional cost of this equipment may make the project non viable.
- How long will it take to have a connection approved?

## CONCLUSIONS

Biogas systems involve several components that must be properly operated and managed to achieve an economically viable system. These systems hold significant potential for pathogen reduction, odour control and better nutrient management. In addition, under the right circumstances, digesters will result in new economic opportunities for farmers and rural communities.

The Standard Offer Program will provide some incentive to farmers and others to consider when developing biogas systems.

## OTHER RESOURCES

The Ontario Power Authority's Standard Offer Program website provides program details for the SOP (www.powerauthority.on.ca). Agriculture and Agri-Food Canada's ManureNet (res2.agr.ca/initiatives/manurenet) contains significant details on AD systems around the world and in Canada. Lastly, OMAFRA's website, particularly the energy links found under the Engineering section, provide useful information, including OMAFRA Factsheets, an anaerobic digestion video, links to conference proceedings and links to other energy resources.

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